



# MakerMeter

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## TOOLS:

- [Digital multimeter \(1\)](#)
- [Hot Glue gun & hot glue \(1\)](#)
- [Soldering iron \(1\)](#)

## PARTS:

- [Tactile switch \(4\)](#)
- [On/off switch \(1\)](#)
- [Battery Holder \(B\) for 4 AAA rechargeable Batteries \(1\)](#)

## SUMMARY

Kids of all types need an easy way into electronics or they will get confused or bored with it. Putting electronics into simple blocks that the kids can play with may peak their interest in electronics. A MakerMeter is one or more blocks of electronic components built in a way that the kids can play with. Teaching is more fun if the kids are having fun. My first experience of electronics was with my Dad's Simpson 260 analogue volt/ohm meter. Conductivity is the first step to understanding electronics. The MakerMeter should be built for that group of kids as something they can each take home and play with.

The parents, teachers and supporters will design and build the electronics behind each MakerMeter. They should also design the look of the MakerMeter so that it is safe and easy to use for that group of kids. Keep things simple so that everyone understands the circuits. Let the electronics people deal with the electronic details. With a little graphics skill you can build an informative functional MakerMeter the kids will love and show off to their friends.

Each family or supporter of each kid should pay for or buy the parts for the MakerMeter.

Depending on time you could have a design-and-build meeting and another meeting for the kids, or just one meeting. You must determine if the kids in that group need to know the electronics behind the MakerMeter.

My big-kid fun MakerMeter is designed like a simple breadboard like what us big kids use to test electronics. In my MakerMeter the electronic tests only need the positive voltage because the ground is taken care of by the MakerMeter electronics. With proper instruction the kids will learn electronics like we did.

To make a MakerMeter you will need someone that knows electronics and the building and soldering of something like a MakerMeter. You need a graphics documentation person that can do the art and documents of the MakerMeter. A skilled builder of the parts of a MakerMeter would be nice, but most people just need a little help in this area in the form of a MakerMeter Build meeting.

It is endless what a MakerMeter can be!

MakerMeter should fun for the kids.

Conductivity is tested simply by two metal probes that, when they touch a conductive thing, cause a light to light up. The components needed are a two- to four-AA battery holder, hook-up wire, Thick solid wire for probes and an LED (if your battery source is above 3 volts use a resistor) or light bulb.

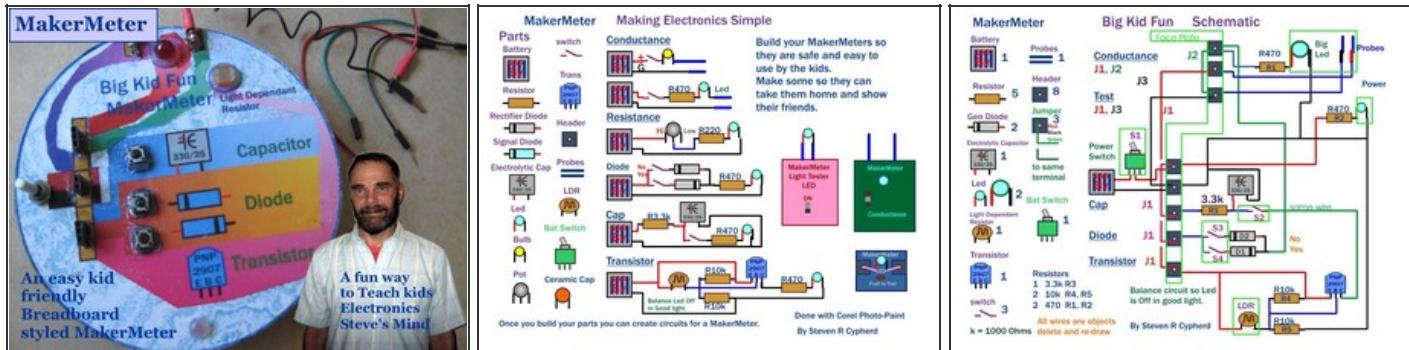
Resistance is demonstrated by adding a potentiometer (pot) or resistor between the light's positive lead and the power lead. The light changes brightness as the pot is turned. Have an internal 220-330 ohm resistor connected between the pot's output and the LED's positive lead to protect the LED.

Capacitance is more fun if they see it in action. Hook the positive lead of the cap to a 3.3k resistor and the other lead of the resistor to V+. Connect a button to the cap's positive lead on one side and then to the light's positive lead on the other side. The battery charges the capacitor through the resistor. Only when the cap is full do the kids get a bright light for a second when button is pushed.

Diodes need hook-up wire or a socket. If the diode is connected one way the light lights and the other way it doesn't. Explain it to them. In my big-kid fun MakerMeter the kid must also attach a jumper from V+ to the diode terminal. This is just how us big kids test a part. Great for a Touch Tag.

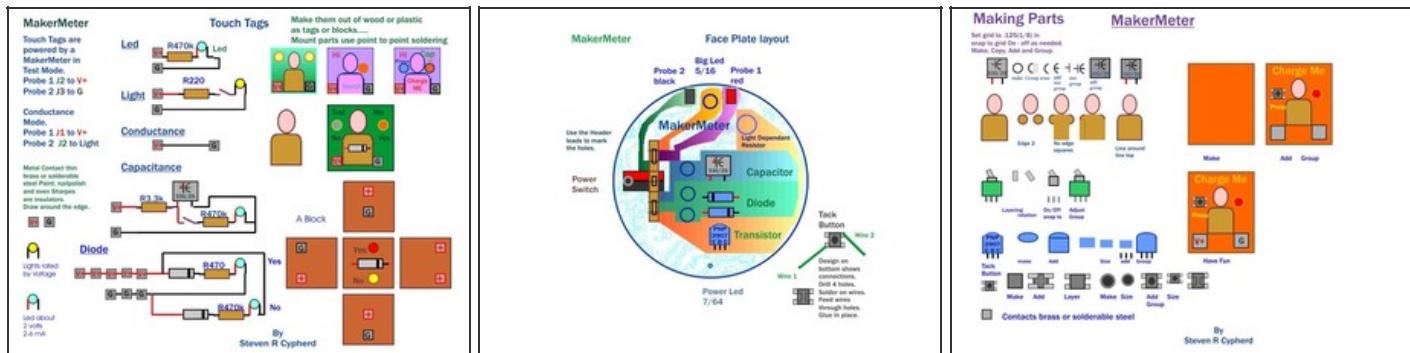
Transistors need hook-up wire or a socket. Use a light-dependent resistor (LDR) and the light changes with the wave of a hand. Use a microphone and the light changes with a sound. Many things are possible.

## Step 1 — MakerMeter



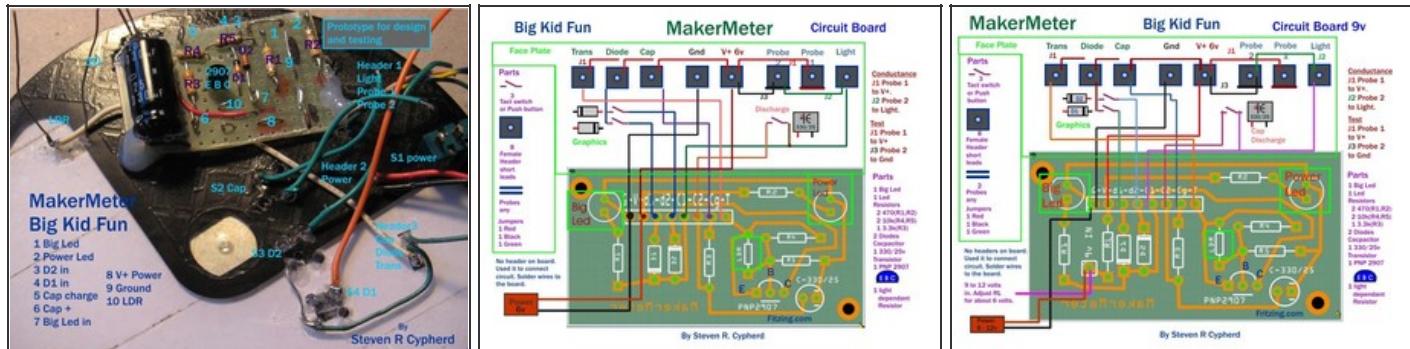
- Have a meeting to see what kind of a MakerMeter you want to build. Work out each circuit and test each part. Keep the documentation simple so that everyone understands it. Then build the MakerMeter on a breadboard and see how it works. A MakerMeter should be fun and informative. A kind of toy to teach electronics.
- Put a kit together for your MakerMeter laying out cost and where to get the supplies. Plan your build meeting for the electronics behind each circuit. Write instructions in the form of a personal workbook for the kids. Write a manual (schematics, details, etc.) for the parents and the supporters of the kids. Plan the MakerMeter meetings.

## Step 2



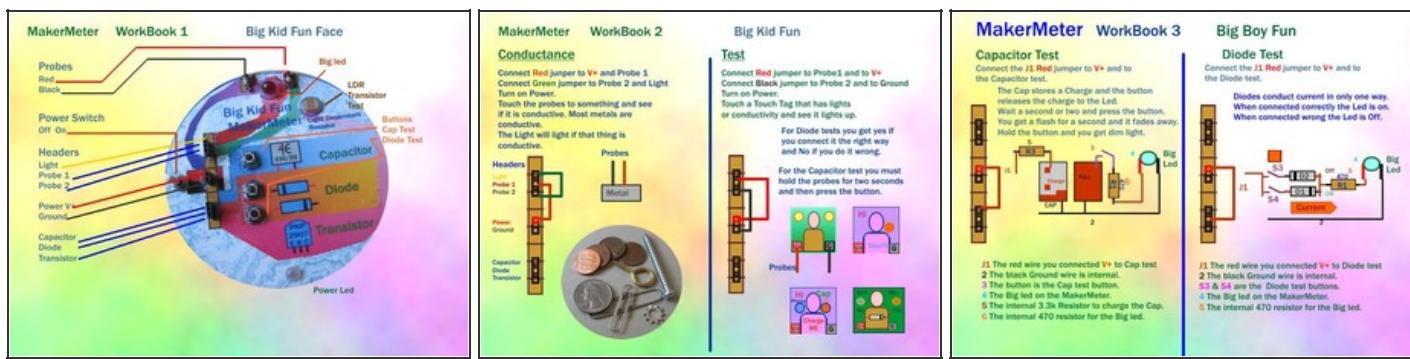
- Graphics can add fun if they are well designed. Make things simple for everyone. Try not to have too many complicated things or applications.
  - I used Corel Photo-Paint and Microsoft Word to make this article. I used [Fritzing](#) to make the circuit boards.
  - The depiction of each electronics component should be fun and only detailed enough to show its function.
  - After the circuits are made and tested make them kid-safe. Any parts that are going to be put on the faceplate should be covered in glue. The gel epoxies are perfect for this. Remember, this is a kid's toy.
  - Touch Tags are little MakerMeters you use to test other MakerMeters.

## **Step 3**



- Make the circuit board for the MakerMeter with all parts visible on the outside. As the kid gets more interested in the electronics you can show them the circuit board. Label things if you want to. Have your instruction book handy so you can show them the circuits. Tape or glue the wires down so that they show how the circuit works.
  - Making printed circuit boards is easy now. Print the PDF at 100%. For laser printers print on the smooth side of the transparency film. Make sure you can read "MakerMeter" when you apply the film to your pre-sensitized board.
  - One circuit is just for 6 volts. The other has a series resistor labeled "RL" that is used to adjust the voltage that powers the circuit. Select RL so that V+ is about 6 volts. For a 9-volt supply RL is about  $330\Omega$ . For 12 volts it is about  $560\Omega$ .

## **Step 4**



- For the kids make workbooks for them to take home. Make manuals for the parents and supporters of the kids.

## Step 5

**MakerMeter WorkBook 4 Big Kid Fun Transistor**

Transistors rule our world. They switch. They amplify. They control most devices....

In my MakerMeter I use a Light Dependent Resistor(LDR) to show off a transistor. The circuit is set up to light the Big Led when the LDR is in the dark. Transistors use biasing to control their state.

When the LDR is in the dark its resistance is low when the LDR is in the light its resistance is high. Connect J1 red jumper to V+ and to the Transistor Test Switch on power.

Wave your finger over the LDR and watch the Big led switch On and Off.

**Big Kid Fun MakerMeter Face Plate layout**

Diagram showing the layout of components on the face plate: Power Switch, Probe 2 black, Probe 1 red, Big Led black, 5/16, Light Dependent Resistor, Capacitor, Diode, Transistor, Tack-Button, Wire 1, Wire 2, Power Led 7/64, and a note to use the marker to mark the holes.

**Breadboard Layout**

Photograph of a breadboard setup for the MakerMeter. Components include a Power LED, a Big LED, a Transistor-LDR circuit, a Capacitor, a Diode, a Tack-Button, and a 6V battery. A note indicates "V+ 6V". The breadboard is labeled "Steven R Cyphard".

- Face plate and breadboard.

## Step 6

**MakerMeter Touch Tags**

A/B in Plastic Testers Model Cement Scotch transparent tape

Photographs showing the assembly of touch tags using plastic test strips, model cement, and scotch tape. It includes instructions for soldering wires to metal contacts and gluing parts in place.

**MakerMeter**

Touch Tags Glue parts in Point to point soldering insulation where needed

Photograph of a breadboard with various components connected, including a cap, diode, and touch tags. A note says "Light Me".

**Probes**

Solid Copper household wire Heatshrink tubing Hot melt glue sparkfun.com heatgun

Photographs showing the construction of probes from solid copper household wire, using hot melt glue and heat shrink tubing. It includes instructions for rotating the wire, heating it with a heat gun, and trimming leads.

Hot melt glue sparkfun.com heatgun

Heat with heatgun

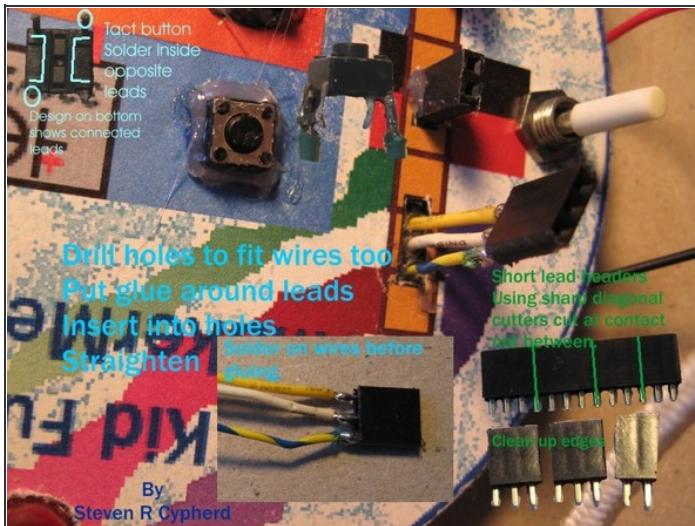
Trim two long and two short

Paperclip makes a spring that can be soldered.

Probes by Steven R Cyphard

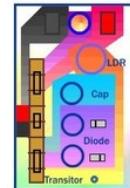
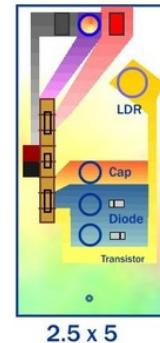
- The female headers simulate a breadboard like us big kids use. The headers are what they call breakable. You cut them apart with sharp diagonal cutters at the contacts, not between them. Clean up the edges. Solder wires to the leads before gluing the part in place.
- The probes I made are simple. Household wiring is perfect for so many things. Thick copper wire makes a good probe. I soldered on a wire and then I put a glob of hot melt glue on it. Quickly put a piece of heat shrink tubing on it and roll it around to spread the glue. Use a heat gun to shrink it. Clean up the excess glue.
- The little tactile buttons are cheap and easy to use. The design on the back shows which two contacts are connected together. Usually on the long side. Solder wires to opposite corners on the inside of the lead and this keeps the hole smaller.

## Step 7



**MakerMeter**

**Face Plates**



Use a 9 volt with RL at 560  
Photo 6 volt battery  
Two 3 volt coin batteries  
Four 1.5 volt coin batteries  
A small slide switch for power  
Holes for the probe wires  
Same layout as Big Kid Fun

- Build it
- More Face Plates

Build with printed circuit board.

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